Walls

Stone wall on Chickatawbut Road in Blue Hills Reservation, Milton and Quincy probably constructed by the Civilian Conservation Corps between 1933 and 1941.

Issues

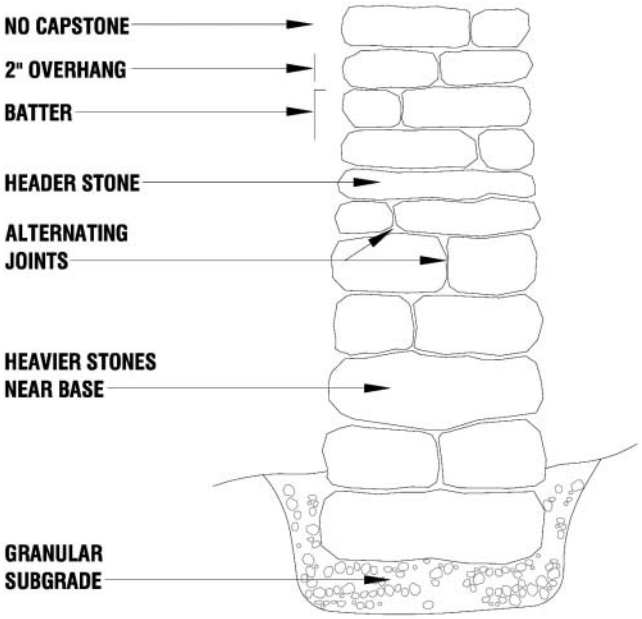
Freestanding retaining stone walls are character-defining features along many parkways. Pre-cast concrete caps and mortared quarried stones are more prevalent in urban areas; fieldstone walls, both dry-laid and mortared, are more prevalent in rural settings. Most date from the original construction of the parkway or state park roadway.

Stone walls are susceptible to external stresses such as collisions, falling trees, invasion by roots, foot traffic, heaving, and differential thermal or freeze-thaw expansion and contraction. Masonry stone walls are susceptible to the different expansion and contraction rates of stone and mortar. Improper mortaring accelerates moisture damage.

Retaining walls may also be constructed of reinforced concrete. Some walls include railings such as the "Boston pattern" railing, as found on Memorial Drive along the Charles River Basin.

Goal

Preserve existing walls.



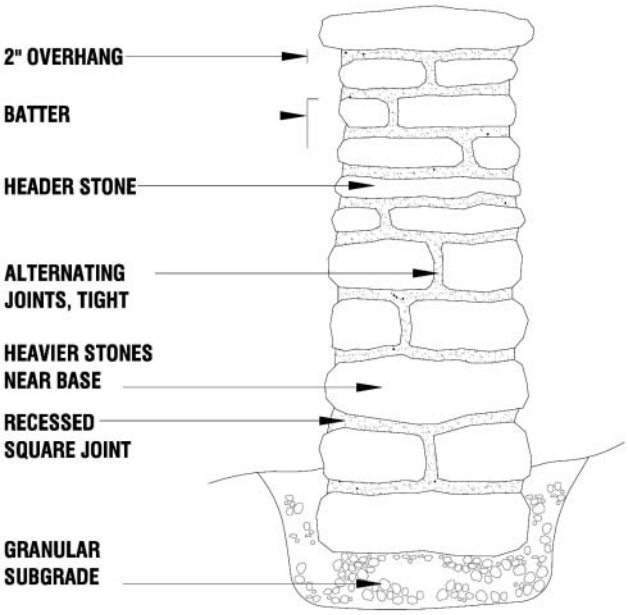
DRY LAID WALL

- If stone walls require repair or replacement, use stone with the same texture, quality, and size. Use mortar that matches the historic color and joints, recessed to same dimension as the historic wall. Repair dry-laid walls as dry-laid. Undertake all new stonework according to the best stonemasonry practices. Where traffic and safety considerations permit, install dry-laid stone walls, since they are generally less expensive to maintain than masonry stone walls.

- In unusual cases where the original design is significantly more maintenance-intensive than current construction, allow historically acceptable modifications to increase durability. In new construction, such as thick stone veneer over a concrete core, replicate the materials, texture, and quality of the historical stonework to provide the same visual character as the original.

- When rehabilitating a dry-laid wall, investigate the subgrade to assure free drainage and absence of silts and do not use mortar to repair it because this will increase internal stresses. The thicker the wall, the less maintenance will be required; good construction will exceed engineering minimum thickness recommendations for retaining walls or high free-standing walls.

- Use local stone if possible.



MORTARED WALL

- For mortared stone walls, use natural sands and air-entraining admixtures to reduce freeze-thaw damage. Match the historic mortar color. Never use premixed mortar-sand combinations. Do *not* assume that locally available sand meets the necessary requirements.

- Replace missing capstones or header stones, to curtail water damage within the wall, with overhang and heavy enough to resist foot traffic. If a mortared wall lacks a capstone, introduce a capstone only if historically compatible. Have a sufficient overhang to deflect water away from the wall, avoid thin vertical edge, use recessed joints, control joints, and appropriate unobtrusive flashing. Choose compatible materials. At suitable spacing intervals or at a change in the wall support, place control joints. If the wall did not have a capstone or header stones, use a sealant on top of wall only (used elsewhere it traps moisture).

- For retaining walls, intercept uphill surface drainage by either sloping backfill away from the wall to promote lateral drainage and assure that no runoff pours over the wall or providing an impervious swale along the top of the wall deflecting drainage around the wall or to area drains. If an existing masonry wall without weep holes is to be rebuilt, introduce weep holes, and assure adequate inward batter, in accordance with standard retaining wall design. Use crushed stone on the upper side to encourage drainage away from the wall.

- If railings on retaining walls need to be replaced, match the appearance and dimensions of the original as closely as possible, consistent with applicable safety standards and codes.

- Remove plants such as small trees that have taken root between the stones to avoid eventual toppling of the wall. Remove graffiti by techniques gentle enough to avoid inadvertent surface damage. Never use mortar to patch or stabilize dry-laid walls to avoid damage from entrapped internal moisture.

Utilities

Issues

The clutter of overhead wires diminishes parkway character. Utility poles and wires were added after parkway trees reached maturity. Cable and fiber optic wires now share poles with electric and telephone. Branches of stately trees encroach on the wires and require pruning. When trees die, replacement locations are hard to find in some narrow parkway corridors.

Planting smaller species that will not compete with the lines will eventually change the character of historic parkways and is not an appropriate solution. Trees will always require selective pruning in order to co-exist with utility lines. Where this level of maintenance is not practical, underground utilities have the substantial aesthetic benefit of removing wires from the landscape.

Sometimes utility companies pay to use parkland for their utility lines and add many above ground features including fenced in transformers. Utility companies conduct all work involving their own facilities, although there are exceptions. They require access onto the landscape to perform servicing tasks. Policies relating to collaboration between DCR and utility companies are important to the maintenance of historic parkways.

Goal

Minimize visual impact of above ground utilities and minimize impact of utility construction and servicing on vegetation.

Guidelines

- Relocate overhead utility lines as unobtrusively as possible, preferably off the roadway for scenic and safety reasons. Put them underground if feasible.

- As an initial task, conduct an inventory and survey of utility lines and structures, including location and elevations, and have utility companies and responsible public agencies verify and supplement, as necessary, the utility information compiled for the project.

- As early as possible after initiation of a project, coordinate relocation and accommodation of existing utilities in a parkway in order to avoid increased cost and delay.

- Identify available utility company programs for replacement, abandonment, and expansion of utilities even if such programs are only in the planning stages.

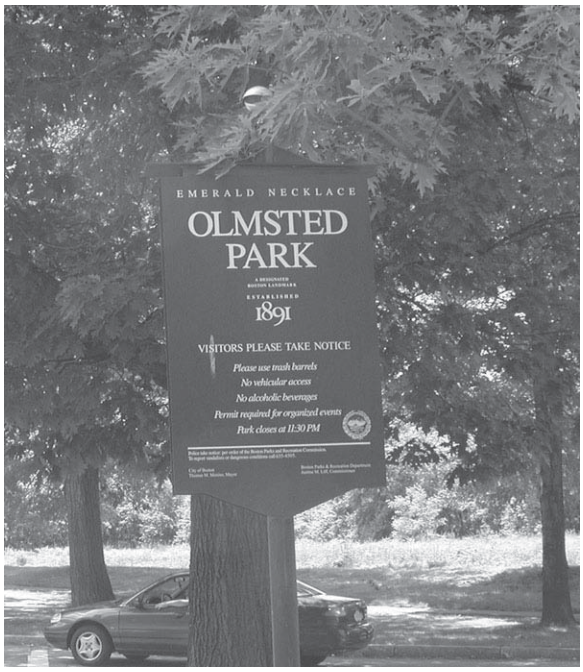
- Identify and assess extent of impacts to existing utilities for the range of design alternatives that are being considered for the project during preliminary design.

- In design, take into account clear zone requirements and post-construction periodic utility servicing to avoid utility vehicle damage to trees and soil compaction.

- On plans and in specifications, illustrate and describe all utility work and include information on the work space, work hours, and work duration requirements of the utility companies.

- Throughout the project duration, maintain and periodically verify complete utility company contact information.

Signage



Issues

Signage is important to the function of historic parkways. There are five basic types:

- Regulatory: enhances the safety of motorists and other parkway users—stop, yield signs, no entry, no U turn, one way traffic, load limit, speed limit.
- Warning: also known as public safety signage (typically yellow) provides information about potentially unsafe road conditions ahead, such as sharp bends in the road, merging traffic, and narrowing lane width.
- Guide: also known as wayfinding signage provides information on destinations and their distances, identifies routes numbers, and indicates directional information.
- Identification
- Interpretation

Regulatory, warning and guide signage adheres to national standards. DCR has its own signage serving identification, and interpretive purposes as well. Here DCR has flexibility in its choice of materials and fonts to reinforce parkway character.

As DCR replaces former MDC and DEM identification signage along the state's historic parkways, it can introduce signage that evokes their special historic character, and places them in a larger system of special roads across the Commonwealth. A signage system that distinguishes these historic parkways from ordinary roads or highways and reflects their history will send a powerful message to the public about their importance.

Goal

Provide clear attractive signage to promote user safety and inform users.

Guidelines

- Install regulatory, warning and guide signage in conformance to the *Manual on Uniform Traffic Control Devices*.

- Provide warning signage to encourage safer driving and caution where stopping sightlines are blocked or where cyclists and pedestrian share the roadway.

- Avoid or reduce sign clutter. Do not block views (especially water), and vistas. Provide clear direction.

- Use alternatives to the standard steel post mounting systems such as posts with alternative (darker and less reflective) finishes or wooden posts.

- Create a statewide parkway identification signage to distinguish them from ordinary roads, and convey that a particular parkway is part of the larger system of parkways across the Commonwealth. Incorporate a simple graphic symbol to distinguish among the parkway types. Choose fonts, symbols, materials, and sign colors and scale to assure system-wide consistency in accordance with the DCR Graphic Design Standards, and consistency with the *Manual on Uniform Traffic Control Devices*. To further distinguish parkway signage from other highway signage, match the color of the back of the sign to that of the front, rather than metallic. Use dark green paint color (Standard Federal Color #14062) for sign poles to match traffic signals, and, if they are controlled by DCR, light poles.

- Provide interpretive (educational), pedestrian wayfinding, and recreational signage of consistent, coordinated design at trailheads and adjacent recreational parking areas.

Lighting


1917 MDC Boulevard Light

Issues

The lighting of the roadway plays a major role in determining parkway character. Inappropriate roadway lighting can diminish parkway character.

There have been a number of different light fixture designs used over the years; generally, the older, the more compatible with parkway character. Some Connecting Parkways originally boasted Welsbach gas or naptha lights, some displaying the name of the parkway. By the 1920s brighter electric lamps were installed. Styles changed frequently until the arrival of the first cobra head fixtures in the 1950s. In the 1970s and 1980s, the shoe box fixture was often installed on a concrete or metal pole. When mounted on a wood pole within an allee of street trees or on the edge of a stand of trees, it blends in with its surroundings.

Many urban parkways need lights for safe night travel. The most common light—the cobra head on a metal or precast concrete pole —diminishes the historic appearance of the parkway. The use of wooden poles is compatible with parkway character, but cannot offset the cobra head effect.

Fortunately, many Internal Park Roads do not have lights or require them. Some are closed at night, others are closed to vehicular traffic. However, in a few cases shoe box fixtures have been placed on wooden utility poles.

Responsibility for lighting service and maintenance is often shared by the managing agency of the parkway, the community through which it passes, and the utility company. Different interests often control the pole, the fixture, the luminaire, and the wiring. Although DCR may not have control over the choice of fixture now, over the long term it may be able to work with the utility companies to offer a historically compatible fixture that meets these guidelines.

Goals

Where required for safety, maintain minimal safe lighting with consistent, uniform historically compatible fixtures along a parkway.

Guidelines

- On parkways where lights are required, provide sufficient and uniform level of illumination, avoiding dead spots between fixtures and glare that might compromise the vision of the driver. To reduce glare, sky glow, light trespass onto abutting private property**,** and reduce energy waste, use fully shielded fixtures with cut-off optics, with reflector and flat lens rather than the more commonly used round prismatic lens. Light color should avoid amber/yellows of low-pressure sodium (LPS) or high-pressure sodium (HPS) or cool white of metal halide.

- On urban parkways in the metropolitan Boston area, use the 1917 MDC Boulevard light.

- For poles, use either metal with dark green paint color (Standard Federal Color #14062), or dark-stained wood. Avoid light colors or reflective metallic finishes.

- Avoid inconsistency of design between roadway and pedestrian fixtures on adjacent walkways. For roadway lighting, provide poles no more than twenty (20) feet in height. For pedestrian lighting, provide poles no more than twelve (12) feet in height.

- Coordinate location and spacing of poles to assure even spacing and alignment with tree rows and if possible traffic signal poles as well. Make every effort to avoid conflicts with mature street trees.

- Use light fixtures of historic design, reduced level of illumination not to exceed 0.4 foot candles on the roadway, reduced height, and closer spacing.

- If historic fixtures survive, make every effort to preserve them as character defining features. To improve performance, adapt them to accept better performing luminaires or replacement to match historic appearance as closely as possible. Adjust spacing or locations if necessary to improve performance.

Bridges

Bridge - Historic Blue Hills Parkway

Issues

Parkway bridges carry motorists, pedestrians, and cyclists over other roadways, pathways, rail lines, and waterways. Bridges over the roadway may carry vehicular or rail traffic. There are also pedestrian overpasses.

Stone Arch Bridges display the technology and craft of the period during which they were constructed. The arch itself may be formed by a stone, brick, concrete, or corrugated metal liner. Parallel to the sides of the roadway and below the level of the road surface are walls that retain the embankment. Some arch bridges have parapets extending above the level of the roadway surface and, in most cases, these are extensions of the retaining walls. The interior of the structure is usually filled with a granular material topped by the roadway surface or pavement. Some of the bridges have curbs along the road, paved walkways and grassy embankments. Where the arches extend over waterways there may be a riprap slope protecting the embankment from scour.

Stone Veneer Bridges, with an exterior of stone masking the reinforced concrete structure, were constructed in more recent times, mostly on urban parkways in the former MDC system, but their finishes give them an appearance that integrates them well into the historic parkway landscape. These structures typically include concrete barrel arches with stone fascias and solid stone or stone veneer parapets.

With the advent of motorized travel, these historic structures underwent changes that affected their appearance and longevity. For example, roadway approaches to bridges were raised to eliminate abrupt changes in slope in the roadway and provide a smoother and safer roadway profile for motorized vehicles. As a result of this construction, bridge parapets were partially buried. Consequently, the retaining walls to which the parapets are attached have been subjected to unanticipated loading and to moisture associated with the material used to raise the roadway profile. Both of these unanticipated conditions lead to accelerated deterioration of the structures.

Appropriate maintenance is essential to preserve these bridges. When bridge work is required, an evaluation of current user requirements should be made as part of the project to determine the type and extent of structural alterations needed to adapt the structure for current uses in an historically appropriate manner. Fortunately, many of the stone veneer bridges are well designed, low-maintenance and add to parkway character.

Bridges are generally maintained and rehabilitated with a separate report and construction contract under a different process than parkways. Through that process, bridges, including parkway bridges, are subject to current MassHighway and federal criteria for structural integrity and safety, which dictate, for example, safe horizontal and vertical alignments and clearances. Because bridges are such important character-defining features of parkways, the guidelines included herein focus on the choice of treatment that affect character rather than structure and safety, which are dealt with under a separate process.

On some heavy traffic parkways, pedestrian overpasses traverse the roadway. They do not reinforce parkway character. New facilities would require extensive ramps to make them handicapped accessible.

Goal

Preserve historic bridges and avoid adding new pedestrian overpasses.

Guidelines

- Research the original structure's design and materials prior to implementing any work. Carry out repairs using preservation techniques that match the materials and craftsmanship of the original. When alterations are needed, retain or reproduce the appearance of original structure to the greatest extent possible. Identify sources of historically acceptable building materials so that smaller repairs can be performed quickly and satisfactorily.

- Use latest technology to identify and correct the underlying causes of distress at historic bridges, but integrate the work with the original appearance unless hidden.

- For parapets, refer to guidelines on Walls.

- Monitor embankments at bridges to control the detrimental effects of water. Add riprap to slopes at bridge abutments to mitigate the potential for erosion. If necessary, alter roadway drainage to eliminate low points where water can collect either on the bridge deck or in close proximity on the approaches. If necessary, regrade the roadway embankments to divert stormwater runoff from the bridge substructure.

- Avoid new pedestrian overpasses and provide adequate and safe roadway crossings wherever possible.

Intersections and Curb Cuts

Parkway terminus points, intersections with municipal roads, traffic signals, rotaries, roundabouts, intersections with non-parkway roads, and with recreational facilities, all affect overall parkway character.

- **Parkway Terminus Points**

  Issues

  Terminus points to the urban parkways often occur at signalized intersections with other busy roadways, while entrance and exit points to the rural parkways often occur at unsignalized intersections with two-lane rural highways or other roadways. These points provide the opportunity to create a defined gateway to the parkway system and reinforce the parkway experience.

  Goal

  Enhance gateway experience at parkway terminus points.

  Guidelines

  - Define entrances to the parkway system.

- **Interface with Municipal Roads**

  Issues

  Connecting Parkways and Border Roads provide smooth relatively uninterrupted travel because they have a limited number of intersections restricted mostly to collectors and local roads. These roads convey general traffic including trucks across the parkway. Municipal sidewalks accommodating pedestrians and bicyclists also intersect with parkways. Treatment over the decades has not been consistent. Parkway character is diluted at busy intersections. Traffic controls, signage, lighting, sightlines, and sidewalks are not necessarily consistent with those elsewhere on the parkway.

  Goal

  Enhance parkway character at intersections with municipal roads.

  Guidelines

  - Provide consistent pedestrian crossing treatments.
  - Provide consistent, safe accommodation for bicyclists throughout the parkway.
  - Design the intersections for the safe accommodation of truck cross traffic if the parkway is for pleasure vehicles only.
  - Add shade trees where they do not interfere with required sightlines .
  - Add landscape and /or hardscape islands or bumpouts, if appropriate. Incorporate landscape if appropriate.

- **Traffic Signals**

  Issues

  Traffic signals have been introduced throughout the parkway system as traffic volumes have increased. The most essential safety and guide signing are appropriate and necessary for the safety and guidance of parkway users. In urban areas, the introduction of traffic signals has in some cases adversely impacted the aesthetics of the parkway corridor, but has also improved safety and access for many users.

  Goal

  Provide required traffic signals as unobtrusively and sparingly as possible.

Guidelines

- Remove unnecessary devices if warranted based on the *Manual on Uniform Traffic Control Devices*.

- Install traffic signals only where warranted based on the *Manual on Uniform Traffic Control Devices* and where needed for safety and capacity reasons. Provide mast arms when necessary to align signal pole with streetlight poles and tree trunks.

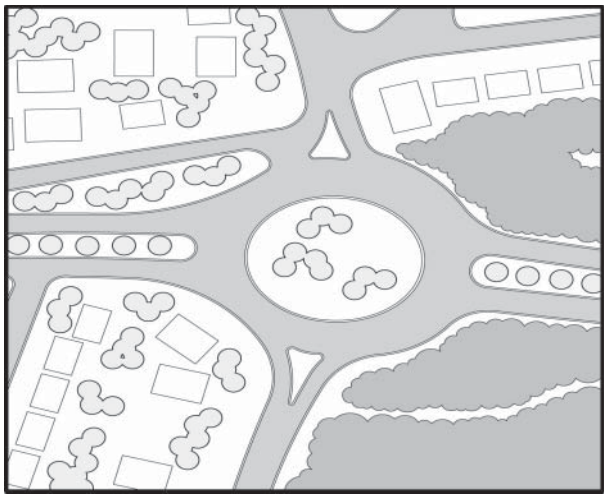
- Coat traffic signal equipment and large sign structures with dark green paint color (Standard Federal Color #14062).

- Provide signal phasing for protected pedestrian crossing.

- Where there is a need to facilitate pedestrian crossing on lower-volume parkways, install a pedestrian activated signalized crosswalk.

- Coordinate timing of traffic signals to provide desired parkway operating speed of 30-35 mph.

- **Rotaries and Roundabouts**



Issues

At rotaries, approaching motorists drive around a circular center island in a counterclockwise direction without stopping. There are usually a central island and channelization islands. These islands of trees and shrubs contribute to the historic character and integrity of Connecting Parkways. On most Ocean Parkways rotaries facilitate traffic flow and are an integral feature of their historic design. Rotaries with channelization islands provide refuge for pedestrians. Single island rotaries can be daunting to pedestrians wishing to cross the road.

Roundabouts are smaller, and include channelization or splitter islands. The alignments of approaching travel lanes and splitter islands require road users, including cyclists, to slow down or stop in order to enter the intersection. Such designs can be safely combined with pedestrian crossings, and are a recommended rehabilitation treatment of a rotary configuration that is part of a parkway's historic design. Roundabouts are included in the MassHighway *Project Development and Design Guide*.

All of the available options can be made safer if combined with traffic calming measures that are appropriate for the functional classification of the parkway including enhanced or raised pedestrian crossings and specific pavement marking improvements.

Goal

Preserve or rehabilitate character-defining rotaries as appropriate.

Guidelines

- If a rotary is an impediment to pedestrian cross movements, redesign as a roundabout and integrate pedestrian crossings.

- Do not change a roundabout to a traffic signal or other control which can aggravate queuing of cars and create bottlenecks during peak hours of use, unless necessary for safety reasons.

- Where historic rotaries are being replaced with modern roundabouts, integrate pedestrian accommodation, including crossings into the design.

- Avoid reduction of the central island diameter of the rotary.

- **Interface with Public Recreational Facilities**

The Summit Road at Purgatory Chasm State Reservation in Sutton provides off-road parking for a spacious picnic shelter.

Issues

Because Connecting Parkways are recreational spaces, over the years some now have active recreational facilities such as hockey rinks, stadiums, baseball diamonds, basketball and tennis courts, and skateboard parks. In some parkways, these facilities have diminished parkway character, reduced space available for passive recreation and blocked views. Other recreational facilities, such as the picnic shelters built by the CCC along Internal Park Roads, are character-defining features.

Goal

Preserve and enhance the passive recreational functions of parkways. Minimize impact of active recreational facilities

Guidelines

- Screen intrusive facilities such as hockey rinks and swimming pools and their parking into the parkway. Avoid building such facilities along the parkways. If these facilities do not need to be on the parkway in order to function, relocate them, for example to an urban lot, and reclaim the parkland for outdoor use.

- If additional parking is needed and space is available, choose off-road locations that minimize loss of parkway features. Design parking facilities to a high standard.

- **Curb Cuts**

  Issues

  Parkways usually control access to abutting private land to protect resources, enhance the recreational experience, and improve safety. In the MDC era, curb cuts were granted to abutters of parkways. Owners of abutting property can be expected to continue to seek curb cuts to increase accessibility to their property, and potentially increase property value as well. Curb cuts undermine parkway character by substituting paving for vegetation, and by adding vehicular traffic. Parkways in urban commercial areas are already operating at or beyond capacity. Granting even one curb cut sets a bad precedent for the future. Widening an existing curb cut to a commercial property, ostensibly for safety, in fact allows faster speeds rather than calming them. Incremental alterations damage parkway character. The appearance of certain segments of Revere Beach Parkway is a case in point.

  Goal

  Avoid adding curb cuts along parkways. Avoid expanding existing curb cuts. Allow no net loss of parkland where a curb cut is allowed or expanded.

  Guidelines

  - Do not add curb cuts along parkways that are operating at or beyond capacity.

  - If a curb cut is to be introduced or expanded, mitigate its effect on the landscape by adding parkland equal in area or greater, and adding trees and other roadside vegetation.

Drainage

This section includes guidelines for the roadway drainage, best management practices during construction projects, and culverts and swales.

- **Roadway Drainage**

  Issues

  Stormwater management systems on historic parkway roadways consist of either closed or open drainage systems. Closed drainage systems consist of catch basins or drop inlets, some with sumps and some without, with drain pipe from these structures either connecting to a larger drainage pipe and manhole network or through the roadway embankment with discharge to a ditch or watercourse. Connecting Parkways, River Parkways and Ocean Parkways usually have closed systems where water is conveyed to catch basins and drain inlets. Newer closed drainage systems can be constructed to recharge drainage back to groundwater depending on drainage catchment area, soil properties and local depth to groundwater.

  Open drainage systems consist of swales and ditches, either paved or unpaved, and culverts. Some early Connecting Parkways had cobblestone gutters and no curbs, a system replaced by curbs within the period of historic significance. The drainage systems of many Internal Park Roads and Border Roads are open systems where water is not collected but rather directed off the road surface to culverts, swales, and ditches. Curbing can sometimes be found on parkways with open drainage systems.

  Proper design and maintenance of drainage systems are essential to the positive function and character of historic parkways. Maintenance of both drainage structures and the cross-section of the road will ensure positive drainage of water off the road. Inadequate treatment of surface drainage on the shoulders of many parkways leads to soil erosion, loss of pavement, and undermining of the roadway subbase.

  In addition, drainage systems must comply with current environmental standards. To meet water quality standards for stormwater runoff, the quantity of total suspended solids and other pollutants must be controlled through the design, management, and maintenance of storm water structures. The quantity and quality of storm water runoff are also subject to regulatory control. The standards and methodology for providing compliant drainage systems are described in MassHighway's *Stormwater Handbook for Highways and Bridges*. This publication adheres to the Massachusetts Department of Environmental Protection's policy for stormwater management and it is specifically written for linear drainage systems typical of roadways. The DCR Stormwater Website provides additional references and links to the DCR Storm Water Handbook which includes construction examples that utilize best management practices for parks and parkways.

Goal

Preserve or maintain the effective functioning of roadway drainage systems

Guidelines

- Where alterations to the existing closed drainage system are required, conduct drainage calculations to establish the quantity of runoff contributing to various inlet points to the system. Several acceptable methods, properly applied to best represent watershed characteristics, are available for determining this number.

- Prior to the design of closed drainage system improvements, thoroughly document existing conditions, with a cleaning and video survey if necessary. If during review of existing systems any unauthorized piped connections (drain or sewer) are discovered, document them and whether any flow through the connection is observed. Forward any information concerning unauthorized piped connections to the DCR Chief Engineer.

- On parkways with open drainage systems, provide vegetated infiltration areas where runoff can be directed, minimizing soil disturbance and maximizing stabilization of adjacent land. For swales, either replace continuous paved surfaces with stone spaced to allow some infiltration or recharge to groundwater, or, if maintenance can be provided, use a vegetated swale to allow more storm water to infiltrate to the ground and reduce volume of water to manage and to promote transpiration instead of run-off. Because vegetated swales require mowing two times per season to maintain vegetation height and health and tend to accumulate litter, include periodic cleaning and maintenance in the operation and maintenance plan.

- Where manholes or catch basin will be installed, where possible specify pre-cast concrete manhole and drainage structures instead of brick, which requires more frequent repair and repaving of nearby parkway surfaces, especially in high vehicle traffic areas.

- Where necessary increase unpaved roadway crowns to allow water in open drainage systems to flow more laterally off the road surface into ditches, keeping velocities low and avoiding runoff concentration.

- **Stormwater Best Management Practices**

Issues

During construction, storm water runoff can erode exposed soils, transport pollutants and degrade local water quality. Stormwater must be managed to prevent the possibility of degradation. To be in compliance with the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System Program (NPDES), roadway projects that involve soil disturbance greater than one acre require filing a Notice of Intent with the EPA under the Construction General Permit and preparation of a Stormwater Pollution Prevention Plan (SWPPP). The

SWPPP generally includes the means and methods of controlling soil erosion and water quality degradation and require periodic inspections of the erosion control measures at the construction site.

The designer should be aware of any surface waters within or with hydrological connection to the project site that are Massachusetts impaired waterways listed in MA DEP Section 303(d). Massachusetts DEP has identified certain waterways as impaired due to one or more pollutant or stress factors. Where construction activity may induce discharges of these pollutants or amplify stress factors to receiving waters, use site control measures that are appropriate to improve water quality to manage those pollutants or stresses.

Placement of hay bales and silt fence reduces sediment loads in storm water discharges, controls construction vehicle access and egress, and reduces the tracking of dirt onto adjacent roadways. Use appropriate control measures for the site. If storm water leaving the site appears silted or murky, additional control measures or treatment will be necessary to improve water quality prior to discharge. Where construction activity involves excavation, dewatering may be required if the excavation is lower than the level of groundwater. This may involve continuous pumping and result in large volumes of water to manage on site. Depending on the grade of the site and the adjacent landscape and hydrology, it may be necessary to construct a treatment train, or sequence of one or more treatment units to remove suspended solids or other target pollutants prior to discharge from the site.

For the finished project to be in compliance with DCR stormwater management policies and with applicable federal (USEPA and COE) discharge permits, the policy and performance standards of the Massachusetts Wetlands Protection Act and various state regulations governing surface and ground water quality, the designer must implement the most "practicable" stormwater management practices within the design. These include post-construction operation and maintenance planning and periodic inspections to ensure that drainage systems are operating properly and that no soil erosion is taking place while vegetation becomes established. Best management practices for storm water are listed in the DCR Storm Water Management Plan and in the DCR Storm Water Handbook available through the DCR Storm Water website which can be found at http://www.mass.gov/dcr/stewardship/stormwater/index.htm

Goal

Use best management practices for stormwater.

Guidelines

- Follow appropriate stormwater Best Management Practices (BMPs) including street sweeping, water quality swales, deep sump catch basins, sediment traps, vegetated filter strips, various configurations of detention/retention basin systems, leaching basins, and recharge installations. Where detention of water is necessary to manage storm water peak

flows, consider infiltration/exfiltration galleries constructed underground where soils are suitable (Class A, B or C soils) instead of detention/retention basin systems that detract from historic settings.

- Use design techniques and construction methods to prevent concentrated flow of storm water. Concentrated flows occur along slopes or grades greater than 5%, but can occur from lesser graded surfaces as well if the surface area is impervious or becomes saturated. Where roadway construction involves excavation on slopes, stone check dams installed at the curb line or in the flow path and spaced approximately every 100-feet will reduce run-off velocity and erosion. If roadways are designed to have slopes of 5% or greater, curbing should be used to control storm water and direct it to a collection system.

- Evaluate BMPs to meet the following objectives:

    - control peak runoff rate
    - provide groundwater recharge, where site soils are suitable (Class A, B or C soils) and contain no known hazardous contaminants that could mobilize or migrate in groundwater.
    - maintain acceptable water quality

- Evaluate the effectiveness and practicability of the full range of BMPs by employing a systematic screening process with the following criteria:

    - physical constraints
    - installation, operational and maintenance requirements
    - regulatory restrictions
    - site soils
    - proximity of installation to critical wetland resource areas and other regulated receiving waters
    - contribution from land uses with higher potential pollutant loads than roadways

- Perform backup calculations and documentation in support of the BMP selections in accordance with MassHighway's *Storm Water Handbook for Highways and Bridges*.

▪ Culverts and Swales

Drainage culvert headwalls

Issues

Culverts are covered drainage channels beneath a road that convey surface water runoff from one side to the other. They may or may not tie to the roadway drainage system. They consist of a manufactured metal, concrete or plastic pipe and masonry or concrete headwalls on either side of the roadway embankment. Swales are shallow ditches with gentle side slopes, typically paved or stone lined. Culverts are susceptible to clogging by accumulated debris and headwall root damage. Culverts and swales are susceptible to erosion, often from uncontrolled roadway runoff. The steeper the grades (such as on Summit Roads), the more susceptible the culvert and swale drainage system, and the more critical the need for routine maintenance. Culverts and swales may be considered character-defining features, especially if installed by the CCC.

Local drainage may include paved waterways to channel brooks in the vicinity of the roadway. These are not character-defining, and detract from the landscape.

Goal

Preserve character-defining headwalls and culverts.

Guidelines

- Where stone headwalls of culverts are visible enough to be considered a character-defining feature, do not replace them with concrete unless clad with masonry veneer replicating the visual character of the original. For mortared headwalls, use matching mortar. Do not patch dry masonry with mortar as this accelerates deterioration. Refer also to stone wall guidelines.

- Keep culverts consistently and clearly (but unobtrusively) marked to assure their inclusion in routine maintenance. For culverts with open basins, introduce a grille to screen debris.

- If surface drainage on the roadway is spilling over the edge of the roadway onto the headwall from behind, regrade locally to redirect the runoff to a swale or if runoff is excessive to a grate connected directly to the culvert pipe.

- If the culvert pipe is to be replaced and is highly visible, use the same material as the original. For the rare culverts constructed with stone channels, preserve them when possible even if not highly visible.

- Remove paving from paved waterways and restore to natural soil and vegetated state if feasible. Where pavement has been necessary to stabilize the stream bed or banking, place stone pavers, field stones, or synthetic matting covered in stone to stabilize the stream bed and banking. Avoid placement of loam in swales. Loam is high in nutrients and erodes quickly. Consider using a synthetic mat or vegetation anchor to secure vegetation temporarily until it can become established.

- Where a culvert must be replaced over a perennial stream ACOE regulations (implemented through local conservation commissions) require an appropriately-sized box culvert instead of a piped culvert to allow wildlife passage and improve flood control.